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Knowledge and awareness of orthodontists to the effect of different medications that influence tooth movement: A cross-sectional study in Saudi Arabia

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ABSTRACT

Background: Orthodontists should be aware of the potential ramifications of certain medications that may affect the cellular and molecular biology of orthodontic tooth movement (OTM). *Aim*: The purpose of this study was to examine orthodontists' knowledge and understanding of the effects of numerous popular medications on OTM in Saudi Arabia. *Materials and method*: In this cross-sectional study, a structured, close-ended, and self-administered online questionnaire was sent to the orthodontists registered with the Saudi Commission for Health Specialties and were practicing in Saudi Arabia. The questionnaire consisted of 24 items under the sections of Demographic and practice characteristics, medical history and medication awareness, and knowledge of the effect of medication on orthodontic tooth movement. A total of 138 orthodontists responded to the questionnaire. The data obtained from the participants were analyzed by applying descriptive statistics, Mann-Whitney and Kruskal-Wallis tests. *Results*: The total mean knowledge of medication in the study sample was 2.99±1.32. A large percentage of study participants were knowledgeable about the effect of Paracetamol (90%), NSAIDs (81.9%), and Bisphosphonate (71.0%) medication on OTM. On the contrary, the effects of prednisolone, losartan, propranolol, and statins family were known only for less than 20% of the sample. Comparison of mean medication knowledge of OTM across studied demographic variables did not yield any statistically significant difference ($p>0.05$). *Conclusion:* The Saudi orthodontists who participated in this study lacked knowledge regarding the effects of common medications on OTM.

Keywords: Knowledge, medication, Orthodontic tooth movement, orthodontist

1. INTRODUCTION

For all ages, demands for orthodontic treatment have been increasing to improve aesthetics, self-esteem, and function (Capelozza Filho et al., 2001; Capelozza Filho et al., 2012; de Couto Nascimento et al., 2016; Uhac et al., 2021). Orthodontic treatment depends on the movement of teeth within the alveolar process by applying forces distributed to teeth and there by transmitted to adjacent tissues triggering multiple molecular and cellular cascades of events (Li et al., 2018). Three theories were proposed to explain the basis of orthodontic tooth movement, bone-bending theory, biological electricity theory, and pressure-tension theory. However, the majority advocate the concept of remodeling that takesplace in the periodontal tissues, which is then coupled interactions of bone resorption and deposition carried out by osteoclasts and osteoblasts, respectively, resulting in structural changes and consequent OTM (Li et al., 2021).

Evidence-based research indicates that orthodontic tooth movement can be affected by several medications. The number of individuals undergoing orthodontic treatment while using over-the-counter or prescription medicines is on the rise (Dhenain et al., 2019). Recentpapers havebeen published on the effects of corticosteroids during orthodontic tooth movement since corticosteroids are used in several conditions such as asthma, allergies, and rheumatoid arthritis. Moreover, they are also known to play a role in bone turnover. Animal studies on corticosteroids have shown an increased OTM. Recent evidence suggests that the main effect of corticosteroids in bone tissue is direct inhibition of osteoblastic formation, accordingly decreasing bone formation. Thus, it seems that corticosteroids increase the rate of tooth movement. However, because of the difficulty in bone formation, corticosteroids generally decrease orthodontic treatment stability (Abtahi et al., 2014).

Orthodontic patients encounter a sense of pain or discomfort during the treatment period, more commonly in adults, which leads them to use analgesics for a few days to relieve the pain (Oliver and Knapman, 1985). However, since taking medications during orthodontic treatment may impact the biomaterial processes that promote orthodontic tooth movement, a thorough understanding of the potential effect of these medications is mandatory (Kaklamanos et al., 2020a). Although the most commonly used medications for managing orthodontic pain are non-steroidal anti-inflammatory drugs (Krishnan, 2007), significant concern about this category is their potential effect on OTM pace by interfering with the activity of the cyclooxygenase enzyme (Bartzela et al., 2009). Few studies conducted on animals concluded that paracetamol, an analgesic, showed no effect on the rate of OTM. However, ibuprofen and indomethacin, analgesic, and anti-inflammatory medications decreased it (Kaklamanos et al., 2020b). On the other hand, celecoxib and aspirin did not show consistent effects (Kaklamanos et al., 2020b).

Indeed, among the substances associated with orthodontic tooth movement biomechanical processes, prostaglandins appear to play a significant role. Non-Steroidal anti-inflammatory drugs (NSAIDs) are among the common medications prescribed for their analgesic anti-inflammatory properties. They may regulate OTM as they inhibit the production of prostaglandins. This inhibition process has been demonstrated to trigger a cascade of events, resulting in a reduction in the number of osteoclast-like cells. Therefore, paracetamol, rather than NSAIDs, is preferred and proposed to be the analgesic of choice for orthodontic pain to prevent any delay in the treatment duration (Kaklamanos et al., 2020b). Besides NSAIDs, studies on anti-hypertensive and anti-hyperlipidemic medications are among the most commonly prescribed drugs in Saudi Arabia (Al Khamees et al., 2018). These drugs have demonstrated diminished bone resorption in individuals taking losartan (angiotensin-converting-enzyme inhibitor) and low doses of propranolol (beta-blocker) due to decreased osteoclasts differentiation (de Oliveira et al., 2014; Moura et al., 2016). On the other hand, statins induce bone formation more than resorption by increasing osteoblast differentiation and inhibiting osteoclasts' activity (ESfaha Ni et al., 2013).

In addition, bisphosphonates prolong the orthodontic treatment by decreasing osteoclast number and activity (Hughes et al., 1989; Hughes et al., 1995; Murakami et al., 1995). Thus, they are antiresorptive drugs used for individuals with bone diseases such as osteoporosis, bone malignancies, and metastasis (Madrid and Sanz, 2009). However, there is a recent shift toward investigating how to utilize bisphosphonates properties in post-treatment retention and prevention of root resorption (Adachi et al., 1994; Liu et al., 2004). Understanding the possible factors that might affect bone remodeling during orthodontic treatment is essential to accomplish maximum benefits and minimum soft and hard tissue damage to the patients. Over-the-counter and prescription medications' consumption has been expanding worldwide (Makrygiannakis et al., 2019). Pharmaceutical substances can affect the mechanically stressed periodontium resulting in inhibitory, additive, or synergistic effects (Diravidamani et al., 2012). Orthodontic patients, including adults or school-aged, are among the individuals who use self-medication or prescribed drugs frequently (Makrygiannakis et al., 2019). Therefore, to achieve a controlled and safe orthodontic tooth movement, the orthodontist's responsibility is to assess the patient's status comprehensively and take an accurate and detailed medication history.

A systematic review of common medications affecting tooth movement listed 12 categories of drugs (Makrygiannakis et al., 2019). Unfortunately, it is unknown how far orthodontists are knowledgeable and aware of the effects of common medications on

OTM. There is a need to assess the knowledge of orthodontists regarding the effects of some common medications on OTM since literature lacks reported studies on this topic in Saudi Arabia. Hence, the study aimed to assess and evaluate the orthodontists' knowledge and awareness regarding the effects of several common medications on orthodontic tooth movement (OTM) in Saudi Arabia.

2. MATERIALS AND METHOD

It was a descriptive cross-sectional study carried out among the orthodontists working in Saudi Arabia. The Research Center of Riyadh Elm University approved the study SRS/2020/14/193/185. This study was carried out from June-August 2020.

Study participants and sample size

The participants in this study consisted of registered orthodontists practicing in Saudi Arabia. According to the Saudi Commission for Health Specialties, the central government agency for regulating all health practitioners, there are 770 orthodontists registered in Saudi Arabia. The sample size was calculated to be 257 based on the margin of error (5%), the confidence level of (95%) and a response distribution of (50%). However, only 138 responses were considered finally into the study.

Questionnaire content

The English version of the questionnaire consisted of three sections. The first section explained the purpose of the study and that it was completely voluntary for the participants to respond to the questionnaire and answering the questions implied their consent. The second section consisted of the demographic data, including nationality, gender, educational degrees, geographic location of service, place of work, the country from where the postgraduate studies were obtained, and years of practicing. Finally, the third section contained the questions on knowledge and awareness of orthodontists regarding the effects of several medications on tooth movement (Supplementary file).

Validity and Reliability

The Face-validity of the questionnaire was established by considering experts' (an orthodontist and a professor in pharmacy) feedback on the questionnaire items. Afterward, the questionnaire was pilot tested among ten resident orthodontists suggesting adequate reliability of the questionnaire (Cronbach's alfa=0.81).

Questionnaire Administration

A structured, close-ended, self-administered questionnaire was prepared using the Google survey form. The link to the questionnaire was emailed to the practicing orthodontists by accessing the email address from Saudi Commission for health specialties. It took 5-7 minutes for the orthodontists to complete the submission of the questionnaire.

Statistical analysis

The data obtained from the survey were coded and entered into the statistical package for social sciences (IBM-SPSS version 25, Armonk, NY: USA), and analysis was performed. Descriptive statistics of frequency distribution and percentages, mean, standard deviations, and mean ranks were calculated for the demographic variables and knowledge score. A multiple response analysis was carried out for the types of degree obtained and practice sector variables. Similar descriptive statistics were applied to medical history and medication awareness and knowledge on the effect of medication on orthodontic tooth movement. All correct responses of the seven questionnaire items on the effect of medication on orthodontic tooth movement were scored one, and other responses were scored 0. Thus, knowledge scores ranged between 0-7, with a higher score indicating better knowledge onthe effect of medication on orthodontic tooth movement. Normality assessment indicated the non-normal distribution of the data. Hence non-parametric tests, Mann-Whitney U test, and Kruskal-Wallis tests were applied to compare the mean knowledge ranks across different demographic characteristics. A value of $p<0.05$ was considered significant for all the statistical purposes.

3. RESULTS

A total of 154 responses from orthodontists with various degrees and expertise were received and reviewed. Sixteen responses were removed, 10 of them were duplicates, and 6 did not meet the eligibility criterion "practicing in Saudi Arabia", ending with a total of 138 responses from 49 non-Saudi (35.5%) and 89 Saudi (64.5%) orthodontists. The majority of the participated orthodontists were males 75(54.3%) having studied in Saudi Arabia 62(44.9%). More than half of the orthodontists were 87 (63.0%) were practicing in

the central region of Saudi Arabia having >10 years of practicing experience 47(34.1%). Most of the participants had a master's degree in orthodontics working in the private sector. The demographic and practice characteristics of the study participants are displayed in (Table 1).

Table 1 Demographic and practice characteristics of the study participants (n=138)

Variables		n	%
Nationality	Non-Saudi	49	35.5%
	Saudi	89	64.5%
Gender	Female	63	45.7%
	Male	75	54.3%
Country from where degree received	Saudi Arabia	62	44.9%
	Middle East	19	13.8%
	America	21	15.2%
	UK	8	5.8%
	Europe	14	10.1%
	Asia	14	10.1%
Region	Central	87	63.0%
	North	3	2.2%
	South	2	1.4%
	East	13	9.4%
	West	33	23.9%
Years in Orthodontic practice	Residency	26	18.8%
	1-5 years	39	28.3%
	6-10	26	18.8%
	>10	47	34.1%
Degree † (Responses=199)	Master	75	37.7%
	PhD	17	8.5%
	Clinical Certificate	26	13.1%
	Board	58	29.1%
	Trainee Resident	21	10.6%
	Others	2	1.0%
Practice sector † (Responses=181)	Public	51	28.2%
	Private	87	48.1%
	Academic	43	23.8%

† Multiple response analysis

Although 90.6% of the orthodontists take a detailed medical history, yet only 31.9% review it with the patient every visit. Nearly 97.8% of the study participants expressed their awareness of common medication affecting orthodontics tooth movement. Medication awareness of the study participants is shown in (Table 2). The effect of NSAIDs (81.9%) and Bisphosphonate (71.0%) medication in the slowing of orthodontic movement is known to a high percentage of orthodontists. Similarly, no effect of paracetamol in orthodontic movement is correctly responded to by (90.6%) of the orthodontists. On the contrary, the effects of prednisolone, losartan, propranolol, and statins family were known only for less than 20% of the sample (Table 3).

Table 2 Medical history and medication awareness among the study participants (n=138)

Items	n	%
Take a detailed medical history from patients	125	90.6%
Review and update the medical history on every visit	44	31.9%
Aware common medication affecting orthodontic movement	135	97.8%
Knowledge of Prednisolone	83	60.1%
Knowledge of Losartan	52	37.7%
Knowledge of Propranolol	80	58.0%
Knowledge of Statin	64	46.4%
Knowledge of Bisphosphonates	115	83.3%

Table 3 Knowledge on the effect of medication on orthodontic tooth movement (n=138)

Medications	Slows[#]	Accelerate[¶]	No effect[*]	Controversial	I do not know
NSAIDS[#]	81.9%	0.7%	7.2%	7.2%	2.9%
Paracetamol*	2.9%	0.7%	90.6%	1.4%	4.3%
Prednisolone[¶]	32.6%	10.9%	3.6%	7.2%	45.7%
Losartan[#]	14.5%	1.4%	10.1%	2.9%	71.0%
Propranolol[#]	18.1%	4.3%	16.7%	5.8%	55.1%
Statin[#]	11.6%	1.4%	19.6%	5.8%	61.6%
Bisphosphonates[#]	71.0%	6.5%	2.9%	2.2%	17.4%

#,*,¶ indicates correct answers to the respective medication's effect on tooth movement, and a score of 1was given.

Table 4 Comparison of mean medication knowledge score of orthodontic tooth movement and demographic variables.

Variables		Mean	SD	Mean Rank	MW-U/KW	p
Nationality[§]	Non-Saudi	2.73	1.54	62.49	1837	0.110
	Saudi	3.12	1.17	73.36		
Gender[§]	Female	3.19	1.26	75.78	1967	0.077
	Male	2.81	1.35	64.23		
Country from where degree received[Δ]	Saudi Arabia	3.10	1.29	71.34	9.399	0.094
	Middle East	2.89	1.41	67.82		
	America	3.24	0.89	80.36		
	UK	2.75	0.89	62.88		
	Europe	2.14	1.61	43.14		
	Asia	3.21	1.58	77.50		
Region[Δ]	Central	3.10	1.37	71.64	2.43	0.657
	North	3.00	2.65	80.17		
	South	2.50	0.71	53.50		
	East	2.92	1.50	74.65		
	West	2.73	0.98	61.82		
Years of experience inOrthodonticpractice[Δ]	Residency	2.73	0.83	62.62	2.548	0.467
	1-5 years	3.03	1.14	72.04		
	6-10	3.19	1.47	77.88		
	>10	2.98	1.58	66.56		

§ Mann-Whitney U test (MW), Δ Kruskal-Wallis test (KW). overall mean score=2.99±1.32

The study sample's total mean medication knowledge score on OTM was determined to be 2.991.32. The comparison of mean ranks across different nationalities (p=0.110) and gender (p=0.077) using the Mann-Whitney U test did not reveal any statistically significant difference in medication knowledge of orthodontists. A similar comparison of mean ranks across the country of postgrad studies (p=0.094), years of experience in orthodontic practice (p=0.467), and region of practice (p=0.657) did not show any significant difference by Kruskal-Wallis test (Table 4).

Mean medication knowledge score of orthodontic tooth movement varied across different qualification levels of the orthodontists. The highest knowledge score was observed among board qualified orthodontists (3.47±1.30), followed by Ph.D. (3.24±1.15), master (2.93±1.29), clinical certificate (2.88±1.45), trainee residents (2.71±1.06), and others (2.50±0.71). Similarly, study participants working in the public sector (3.10±1.25) demonstrated a higher medication knowledge score of orthodontic tooth movement followed by private (3.00±1.38) and academic (2.98±1.20) sectors (Figure 1).

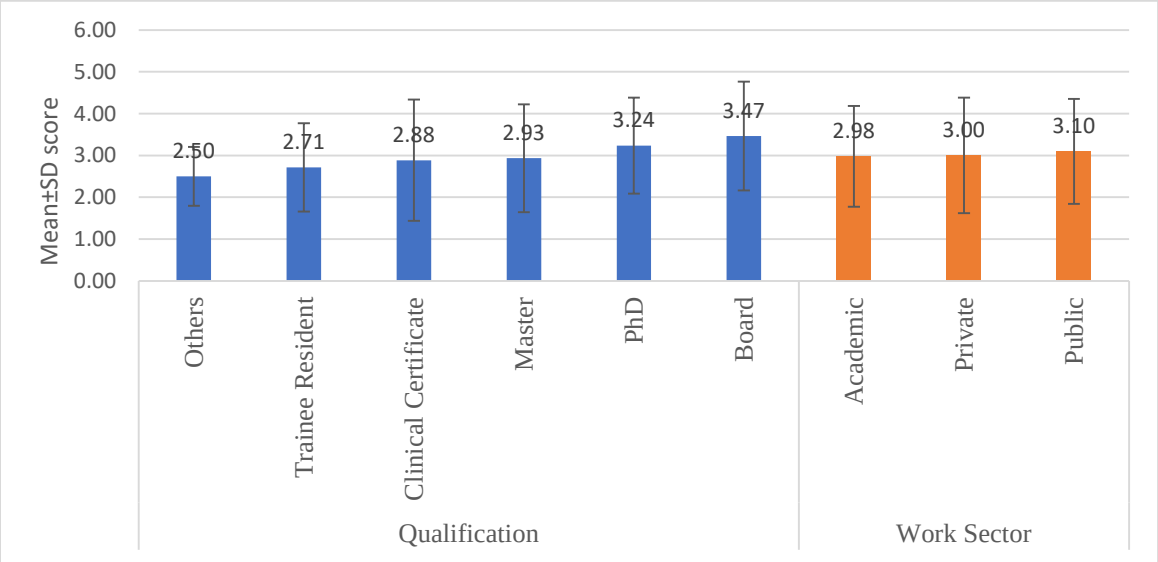

Figure 1 Mean medication knowledge score of orthodontic tooth movement based on qualification and practice sector of the participants

Multiple response analysis was performed to assess the clinical significance of decreased tooth movement. More than half (57.6%) of the responses were related to prolonged treatment duration, followed by pharmacological anchorage (17.1%), reduced post treatment relapse (12.2%) and reduced root resorption (9.3%) as shown in (Figure 2).

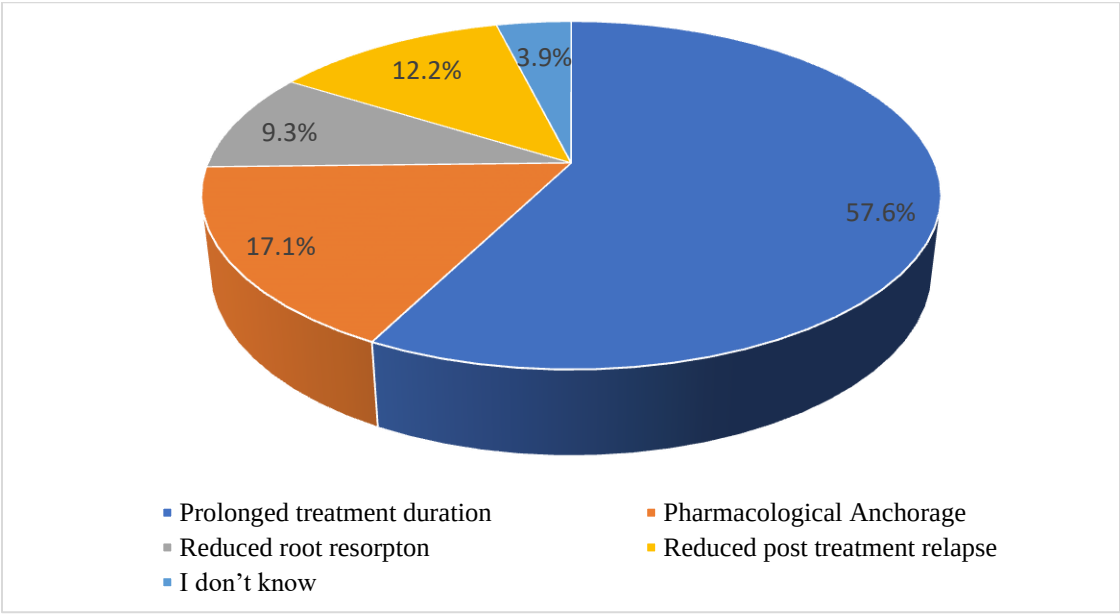

Figure 2 The clinical significance of decreased tooth movement? (Responses=205)

4. DISCUSSION

The purpose of this study was to assess orthodontists' knowledge and awareness of the effects of several common medicines on OTM in Saudi Arabia. The study findings revealed that Saudi orthodontists, independent of demographic or practice factors, had inadequate knowledge and awareness regarding the effects of medicines on OTM. The research participants had a reasonably good level of knowledge of the effects of NSAIDs, paracetamol, and bisphosphonates on OTM. In contrast, less than 20% of research participants were aware of the effects of prednisolone, losartan, propranolol, and statins on OTM. The respondents' increased knowledge of analgesic effects is most likely related to discomfort control during treatment. Moreover, paracetamol is the drug of choice for pain relief in orthodontic cases because it interferes less within tooth movement (Corrêa et al., 2017). Similarly, high knowledge of bisphosphonates may be linked to an increase in the number of older patients requiring orthodontic treatment, an unpredictable treatment prognosis, a high prevalence of adverse dental side effects such as bisphosphonate-associated osteonecrosis, its long half-life in bone, and its effect on soft tissue, including the vascular system and other body systems (Krieger et al., 2013). On the other hand, less knowledge or awareness of the effects of other medications can contribute to a gap in the education and research areas that needs to be bridged by providing adequate information to the orthodontists.

The current evidence emphasizes that the orthodontist should identify their patients' medical status and medication consumption and keep updating everytime. Since medication intake by the patients could lead to difficulty in opening dental spaces or closing pre-extraction or post-extraction spaces requiring a longer time to complete the treatment by an orthodontist. In contrast, some patients take medications that accelerate OTM, necessitating closer follow-up visits (Kaklamanos et al., 2020b; Kaklamanos et al., 2020a). In this study, 68.1 percent of study participants did not examine or update each patient's medical history at each visit. It might be due to a lack of time spent with each patient, a lack of understanding and awareness of the necessity of updating medication records every time, a lack of communication between the orthodontist and the patient, work overload, or ignorance. Medication usage can have a two fold influence on treatment prognosis by either amplifying or inhibiting OTM and influencing root resorption. Furthermore, anchoring issues might be detected. However, precise conclusions about drug effects cannot be drawn because most research is based on animal studies rather than human clinical trials (Kaklamanos et al., 2020a). In this study, respondents were aware of the possible consequences of decreased orthodontic tooth movement. Most importantly prolonged treatment duration, and to a lesser extent, pharmacological anchorage reduced root resorption, and reduced post-treatment relapse.

It is justified to conduct further standardized clinical studies assessing the impact of taking medications in orthodontic treatment because animal studies cannot be extrapolated in humans completely. Knowledge and awareness improvement measures should include; incorporating feedback from the basic courses and modules in postgraduate studies to emphasize on the importance of this topic. Increase the level of awareness by organizing lectures and forums, sending informative brochures through emails to the registered orthodontists in the Saudi Commission for Health Specialties. It is recommended to draw the orthodontists' attention toward new research fields regarding the beneficial use of medications' properties orthodontically. Furthermore, large sample size studies are needed to identify the cutoff point for adequate knowledge of medication's effect on OTM among orthodontists.

Limitations

This study seems to be the first in terms of assessing orthodontists' knowledge and awareness about some medications affecting tooth movement. Therefore, it was difficult to compare and contrast our study findings with other studies. Due to the restricted study duration andless than optimal sample size the results cannot be generalized to all the orthodontists practicing in Saudi Arabia. However, this study provided baseline information on the knowledge gaps of the orthodontists concerning the effect of medications on OTM.

This study focused on self-reported details concerning knowledge on the effect of medication on the OTM among orthodontists. Before addressing any of the queries, participants might likely have searched for the replies, affecting the accuracy of the responses. Participants may likely respond favorably based on what they perceive to be expected of them due to social desirability. Finally, cross-sectional studies are not in a position to include proof of causality. However further investigations in both orthodontists' knowledge and medications effects are warranted with large representative sample.

5. CONCLUSION

The orthodontists who participated in this study demonstrated poor knowledge regarding the effects of several common medications on OTM in Saudi Arabia. Hence continuous dental educational programs by the professional organization should include topics on the impact of medicines on OTM to improve the knowledge of orthodontists.

Contribution

Eman Jameel Fatani: conception and design of the study, analysis and interpretation of data, drafting the article, final approval
Arwa Abdulaziz Mustafa Qawas: Acquisition of data, drafting the article, final approval
Bayan Sulaiman Nasser AlShehri: Acquisition of data, revising the paper, final approval
Nada Abdulaziz Altuwaijri: Interpretation of data, revising the article, final approval
Razan Musaad AlSalamah: Acquisition of data, analysis and interpretation of data and final approval
Baseer MA: Analysis and interpretation of data, drafting the article, final approval

Ethical approval

The study was approved by the research center of Riyadh Elm University (SRS/2020/14/193/185).

Conflicts of interest

The authors declare that they have no conflict of interest.

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Data and materials availability

All data associated with this study are present in the paper.

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